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CONFIDENTIAL

25X1

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April 28, 1955

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[redacted]

Attention: Contracting Officer

Subject: Proposal for a Passive Intercept Receiving System

Enclosure: (1) [redacted] Quotation 591-12 (4 copies) 25X1
(2) Technical Proposal No. 651 (4 copies)
(3) Price Analysis (4 copies)

Gentlemen:

We are submitting herewith our cost plus fixed fee proposal (enclosure 1) for a quantity of three (3) Passive Intercept Systems as described in Technical Proposal No. 651 (enclosure 2) together with spare parts, a final engineering report, various publications, and drawings. A price analysis (enclosure 3) is also attached for your convenience.

We have had several technical discussions with your representatives on this program, and we believe it therefore not necessary to discuss our capabilities to perform this work. Our background which increases our ability to be of service in this program is briefly covered in Section II of the attached technical proposal.

Terms and conditions of our proposal are stated in enclosure one (1). If you have any question on either the technical or financial portions of our presentation please do not hesitate to call on us.

We appreciate this opportunity to present our proposal and anticipate the continuance of our present excellent technical and contractual relations with your organization.

Very truly yours,

[redacted] 25X1

JAC:nrr

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[redacted]

QUOTATION

25X1

TO: [redacted]

591-12

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We offer the following quotation for acceptance within 30 days from this date.

Date April 28, 1955

Item	Quantity	Description	Delivery
1	3	Engineering Models of a Passive Intercept Receiving System generally in accordance with the Department of Defense Exhibit, titled "ELINT Maritime Receiving System-Prototype Design" and in accordance with technical proposal 2.651. Included will be one (1) model 513D Tecktronic Oscilloscope.	1st equipment 6 months after fully signed contract, remainder at 1 per month thereafter.
2	3 sets	Spare Parts for Item 1 above. Each set will contain 50% spares for such items as amplifiers, tubes, etc., and 25% spares for durable hardware items such as antenna horns, etc.	Concurrent with Item 1.
3	10 copies	Final Engineering Report for work under Item 1 above. This report shall provide a summary of all work performed under Item I and shall include all information pertinent to the equipment delivered under Item I except that contained in the instruction guide of Item 4 below.	90 days after delivery of 1st equipment
4	10 copies	Instruction and Operation Guide for the equipment delivered under Item I above. This informal instruction guide shall contain information on the theory of operation, and maintenance of the Passive Intercept Receiving System.	Thirty (30) days after delivery of 1st equipment
5	1 set	Drawings per Section VII B of T.P. No. 651	30 days after Item I.

Total Cost Plus Fixed Fee Items 1-5 $ 277,168

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25X1

[redacted]

QUOTATION

CONFIDENTIAL

25X1

TO: [redacted]

591-12

~~SECRET~~

We offer the following quotation for acceptance within 30 days from this date.

Date April 28, 1955

Conditions:

(1) This award to contain terms, clauses, and conditions of RD-71 insofar as applicable.

(2) Approval of overtime premium not to exceed $1,315.

(3) The extent of environmental testing to be carried on is per Section VIII of T.P. 651

(4) The following Government Loaned Equipment shall be supplied:
One (1) set of high frequency antenna drawings.
One (1) Passive Intercept Receiver System to be held for environmental tests. This will be the 2nd equipment produced.

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Price Analysis
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Description			Amount
Direct Labor	**Man Months**	**Rate**	
Project Engineers	11.2	655	$ 7,336
Senior Engineers	32.5	520	16,900
Junior Engineers	20.1	421	8,462
Technicians	27.2	304	8,269
Model Shop Men	24.5	418	10,241
Design Draftsmen	11.8	488	5,758
Detail Draftsmen	23.9	272	6,501
Process Writers	0.5	340	170
Section Engineer	2.0	837	1,674
Total	153.7		$ 65,311
Overtime Premium			1,306
Burden (26,590 hrs. @ $2.28 per hr.)			60,625
Material ($40,000 for antennas)			61,100
Sub Contracts - Antenna Development			15,000
Handbooks			5,000
Drawing Reproductions			700
Travel Expense			1,800
Environmental Test Facility Use (830 hrs. @ $4.00)			3,320
Total Cost less G & A			$ 214,162
G & A (6.678% of Cost)			14,302
Total Cost including G & A			$ 228,464
Fixed Fee (7% of Cost			15,992
Cost Plus Fixed Fee			$ 244,456

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Price Analysis
591-12
Spare Parts

Description			Total
Direct Labor	Man Months	Rate	
Technicians	1.5	304	$ 456
Total	1.5		456
Overtime Premium			9
Burden (260 hrs. @ $2.28)			593
Material			27,600
Total Cost less G & A			$ 28,658
G & A (6.678% of Cost)			1,914
Total Cost including G & A			$ 30,572
Fixed Price (7% of Cost)			2,140
Cost Plus Fixed Fee			$ 32,712

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[redacted] TECHNICAL PROPOSAL NO. 651 25X1

ON

A PASSIVE INTERCEPT RECEIVING SYSTEM

DATED

19 APRIL 1955

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T.P. No. 651

I. SUBJECT:

A PASSIVE INTERCEPT RECEIVING SYSTEM

II. INTRODUCTION:

This proposal is submitted in response to a request from the Department of Defense for the development of a wide band passive intercept receiving system. The specifications for the subject equipment were outlined by the Department of Defense at a conference held at the [redacted] on March 25, 1955. 25X1

Due to the time schedule set up by the procuring agency this proposal is based as much as possible on existing experience and techniques in the [redacted] ing Laboratories. 25X1

The equipment to be delivered under this proposal is considered to be developmental although the delivery time schedule restricts the majority of hardware to commercially available components. The equipment will be packages so as to resemble a true production prototype, i.e. one that is capable of being mass produced. Some of the transistorized video amplifier design will constitute an advance in the state of the art although it will be based on work which is underway at [redacted] 25X1

The [redacted] feels especially qualified to undertake the development of the subject equipment because of its work in the transistorized crystal video field, and in the development and production of transistors. [redacted] Corporation has been continuously engaged for more than four years in the development of new transistors. At the present time two basic types are in production. They are PNP Junction and Surface-Barrier. 25X1 25X1

Surface-Barrier Transistors, conceived and developed by the [redacted], are in a distinctly new class and represent a significant contribution to the art. They have been described in published papers (1). Surface-Barrier Transistors have certain fundamental advantages over other types for many applications, particularly in their ability 25X1

(1) A series of five papers by various authors, Proceedings, I.R.E, Dec.'53, Pages 1702-1720.

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to combine excellent high frequency performance with low voltage operation and low noise figures. The unique methods of fabrication used in their manufacture results in an unusually uniform product. Surface-Barrier types are incorporated in equipments presently being developed by Philco Corporation for U.S. Navy, Bureau of Ships under Contract NObs-66034. A second equipment now in development (Classified Secret) employs more than 400 transistors per unit.

An airborne computer now under development by Philco on a proprietary basis uses over 2300 transistors per unit.

[redacted] maintains a group engaged in continuing research and development of transistor applications and circuits for both military and civilian purposes. This group is in addition to those primarily engaged in research, development and production of transistors. 25X1

[redacted] has considerable experience, acquired over a decade, in the development, design and production of miniaturized electronic equipments, particularly in the field of Airborne Radar. Recently considerable attention has been given to the development of printed wiring techniques, and complete facilities now exist in the engineering laboratories for the fabrication of developmental designs. 25X1

III. NATURE OF THE PROBLEM:

The requirement which this proposal answers is to monitor and analyze all signals over the frequency band of 50 megacycles to 40 kilo megacycles. A rough bearing on the received signals is desired.

The equipment to perform this function will operate in either of two ways: (1) As an unattended collection system in which case the received information will be recorded on a continuously operating type recorders or (2) as a manned system with one or two operators in attendance. In the case of two man operation one operator will cover the frequencies between 50 and 1000 mcs. and the other operator will cover the frequencies between 1000 and 40,000 mcs.

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The information which is desired in the order of importance is:

1. Frequency band of activity
2. PRF
3. Scan time
4. Pulse width
5. Pulse rise time.

Pulse modulation must be receiver over the 50 mc to 40 kmc range and voice modulation at carrier frequencies below 10 kmc. The pulse characteristics will range between 30 and 6000 cps pulse repetition rate and between 0.2 and 50 microseconds pulse width.

The sensitivity of the receivers should be at least -45 dbm over the entire frequency range. Signal levels which can be expected will range from minimum sensitivity, i.e., -45 dbm, up to crystal burnout levels of approximately /22 dbm.

Although it is considered beyond the scope of this proposal there exists the requirement of extending coverage up to as high as 100 kmc. To provide coverage in this range millimeter crystals and transistors for millimicrosecond receivers will have to be developed.

IV. TECHNICAL APPROACH:

A. General System Configuration

The contractor proposes to design and construct the subject Wide Band Intercept Receiving System generally in accordance with the Department of Defense's Exhibit, titled "ELINT Maritime Receiving System - Prototype Design". The system will be divided into two units; (1) an Antenna Unit which will be a structure mounting the antennas to cover the wide frequency band, along with crystal detectors and video receivers and (2) a Control Console which will contain the alert indicators along with video amplifiers and power supplies. Pulse analyzing equipment will be attached to this unit externally.

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The system will cover the frequency spectrum from 50 mcs through 40 kms in 9 frequency bands:

Band 1.	50-250 mc
Band 2.	250-500 mc
Band 3.	500-1000 mc
Band 4.	1000-2200 mc
Band 5.	2200-4500 mc
Band 6.	4500-10,000 mc
Band 7.	10,000-18,000 mc
Band 8.	18,000-26,000 mc
Band 9.	26,000-40,000 mc

This frequency division is based in part on the capabilities of the existing antenna art and the RF crystal match.

Rough direction finding is obtained by providing four 90° beamwidth antennas with separate receivers for each frequency band arranged so as to give 360° azimuthal coverage. The separately detected video received from each of the quadrant antennas is combined in a cathode ray tube heading stabilized display. The display which also provides the alert function will consist of a radially deflected sweep. The length of the sweep is an integral function of the pulse amplitude or the strength of the incoming signal and the angle of the sweep is proportional to the azimuthal bearing of the incoming signal.

The equipment for transmission modulation analysis will be external to the Control Console although it will be closely integrated. The bandwidth of the system will be sufficiently wide so that negligible deterioration will be experienced in the characteristics of the signals which can be expected over the frequency bands. The outputs of the Control Console will feed (1) an oscilloscope for observing wave shape, (2) a tape recorder or multiple recorders for maintaining a log of all activity, (3) earphones for oral monitoring of the pulse repetition rate or voice modulation.

Except for the externally mounted pulse analyzing equipment (tape recorder and oscilloscope) the system will be completely transistorized. The electronic packages will be extremely small plug-in units consisting of transistors and associated components mounted on printed circuit boards.

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This type of arrangement will provide the best reliability, uniformity, and facilitate the servicing of the equipment.

Test equipment, which will test the over-all performance of the system, will be accessible to the operators so that they can check performance at any time.

The configuration of the Control Console will be designed in accordance with the best principles of Human Engineering Practice. The design will incorporate maximum accessibility of controls and indicators for either one or two operators.

B. DETAILED SYSTEM DESCRIPTION

1. Antenna Unit:

(a) Antennas:

Above 1000 mc. the most desirable broadband, fixed antenna configuration appears to be the horn. Over the 4 frequency bands from 1 kmc to 18 kmc the horns which will be part of the Antenna Unit, will be based on NRL designs with built-in crystal detectors. It is understood that these horn antennas have suitable gain and pattern characteristics throughout their respective frequency bands. Above 18 kmc commercial horn antennas are available, however, their beamwidths are considerably narrower than is desired. Some limited development may be necessary to scale the horns to a wider beamwidth, although this is not considered a problem.

From a cursory examination of the antenna art below 1000 mc, broad band directional antennas seem to be in a rather embryonic state of development. Several forms appear to be suitable above 250 mcs. These include (1) helix, (2) dipole, conical or discone with corner reflector, (3) quadrant balun closed loop (4) cavity, and (5) spiral. Helix antennas exist which were designed for operation at the approximate center frequencies of bands 2 and 3, although they have not been tested over the wide bands. The manufacturer is of the opinion that the

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helix is inherently broadband enough to be useful over our band. The existing design yield a 90° beamwidth at about the 6 db points. According to one manufacturer of corner reflector type antennas who was contacted, receiving elements such as shielded dipoles, conical dipoles, or discones can be broadbanded to cover the desired frequency ranges. The corner reflector would be shaped to provide the wide beamwidth. The spiral type seems to be a very promising antenna development. It is inherently broadband, and quite compact. It can be printed on a flat surface thereby lending itself to mass production. Unfortunately the development of the spiral antenna has just started and will not fit into the scheduling of this program.

Below 250 mcs. most antennas get undesirably large to mount on a small craft such as the PT-Boat type. In order to get the proper pattern without excessive side lobes or back scatter on a corner reflector type, for instance, the reflecting members must be 8' long. Here again the spiral type shows promise of offering moderate gain with very small size although the present scheduling will not permit its investigation. An inverted rhombic type with guy wires as elements might be practical in this application. The elements of the rhombic could be guyed to the structure of the boat and would increase the wind resistance and weight of the antenna stack by a relatively small amount.

One of the first tasks which will be undertaken under the development of this equipment will be a rigorous review of the existing antenna art. Since the equipment to be delivered under this proposal is urgently needed for field test it would be desirable to procure antennas which would not entail the cost and time of a development program. Every antenna manufacturer who has been contacted, however, has indicated that some development would be necessary to handle the lowest frequency band. Since the amount of development quoted time by the antenna manufactures varied widely, an estimate for a minimum

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amount of development time has been made by [redacted] for inclusion in the quotation which is supplied with this technical proposal. It should be noted that the cost involved in antenna development may be subjected to change, although the procuring agency will be informed of any antenna development work which is involved. 25X1

In general the transmissions at the high frequency bands will be horizontally polarized while at the low frequency bands they will be vertically polarized. Ideally the antenna system would pick up transmissions of any polarization with no loss. This is not practical since double the number of antennas, detectors, and preamplifiers would be involved. A practical solution is to use either circularily polarized antennas or to orient the antennas at some angle between the vertical and the horizontal. In the case of circularily polarized antennas, 3 db is lost in the reception of both horizontal and vertical polarized signals. Certain antennas such as the helix receive circular polarization. At the higher frequencies where linear horns already exist, receiving with circular polarization is impractical due to the necessity of a whole new antenna development program and the complication in the RF transmission line. The horns at the higher frequencies will be oriented to favor horizontally polarized signals while at the intermediate frequencies they will be oriented at 45°. The problem of polarization will be studied in detail during the development program.

The second figure shows a possible configuration for the Antenna Unit. The antennas from 1 kmc up will be covered by a single, close-fitting radome. This radome will be rigged with quick-disconnect fasteners for ease in servicing. The antennas covering the bands below 1 kmc. will be weather proofed on an individual basis.

(b) Crystal Video Receivers:

The sensitivity of a video receiver is the

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signal power which equals the noise at the grid of the first video amplifier tube. This signal power P is given by the formula:

$$P = \sqrt{\frac{4\,k\,T\,B}{M}} \qquad (1)$$

where

$$M = \frac{\beta\sqrt{R_x}}{\sqrt{t_x R_x / R_{eq}}} \qquad (2)$$

KTB = Conventional Johnson Noise= 4×10^{-15} watts per megacycle bandwidth (video)

M = Crystal figure of merit.

β = Rectification coefficient in $\frac{\text{microamps}}{\text{microwatt}}$

R_x = Crystal impedance: incremental slope of the current voltage curve.

R_{eq} = Equivalent resistance of the first video tube, usually given a standardized value of 1200 ohms.

t_x = Noise temperature of crystal.

The Crystal Figure of Merit (M) can be taken as 70. This is typical of present day commerical 1N31 crystals and of preliminary tests on [redacted] 25X1 1N263 germanium crystal. Substituting this figure into equation (1) we find that the Signal Power (P) = 9×10^{-10} = -60 dbm. Even though the Figure of Merit (M) of the 1N263 crystal is no better than the 1N31 at the present time it seems desirable to use the 1N263 since plans are now being made to increase M to 100 and reduce the Crystal Impedance (Rx) down to 1000 ohms. With a Figure of Merit of 100, the Signal Power would be -62 dbm. The reduction

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in crystal impedance would be important because a wider R.F. match can be had as the R_X approaches the R.F. transmission line impedance. In fact, the crystal impedance would have to match the R.F. impedance to effect an all pass (dc to 40 kmc) match.

The 1N31 crystal with zero bias and the 1N263 Crystal with forward bias will have an impedance (R_X) of around 10,000 ohms. At this figure and matching into the input circuit of a transistor, the loss over a 2:1 R.F. frequency range will be in the order of 5 db. Over the wider range of Band #1, (5:1 ratio) the loss will run up to 8 db. assuming well calculated matching networks are used.

From equation (1) it is seen that the Signal Power (P) varies as the square root of the video bandwidth. Thus the P will be - .6 db, ⁄ 3 db, and ⁄ 5 db when using a 750 kc, 4 mc. and 12 mc. video amplifier, respectively, as compared to the signal power obtained when using a 1 mc. amplifier.

The video noise figure has similar dependencies to the conventional IF noise figure. For a vacuum tube video amplifier, the video noise figure is proportional to the crystal impedance, With a crystal impedance of 10,000 ohms, the best noise figures using tubes is around 1 db. Using transistors in the video amplifier, the best noise figure that can be obtained is around 6 db. While video amplifiers with tubes have superior noise figures, they are plagued with microphonics. Tubes apparently cannot be made that completely avoide microphonics. Although they can be minimized by raising the low frequency cut off and selecting tubes, the best answer is the transistor amplifier which should have no microphonics whatever.

Pulse video receivers with tube amplifiers have series blocking capacitors between the stages which are charged by grid current for large input signals. The discharge of these capacitors through the grid leak resistors is often excessively long thereby masking out small signals which might occur immediately following large signals. In the transistor amplifiers

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in the proposed equipment the blocking problem can be solved by using dc amplifiers in the narrow band pass video amplifiers. In the wider band-pass amplifiers the low input impedance of the transistors will make the recovering time inconsequential.

The following tabulated results show the minimum detectable signal which can be expected in each of the nine frequency bands:

FREQUENCY BAND	VIDEO BANDWIDTH mc	VIDEO BANDWIDTH REFERRED TO 1 mc	MINIMUM DETECTABLE SIGNAL
1. (50 mc-250 mc)	0.75	-0.6 db	-47 dbm
2. (250 mc-500 mc)	0.75	-0.6 db	-50 dbm
3. (500 mc-1 kmc)	0.75	-0.6 db	-50 dbm
4. (1 kmc-2.2 kmc)	4.0	≠3 db	-47 dbm
5. (2.2 kmc-4.5 kmc)	4.0	≠3 db	-47 dbm
6. (4.5 kmc-10 kmc)	4.0	≠3 db	-47 dbm
7. (10 kmc-18 kmc)	12.0	≠5 db	-45 dbm
8. (18 kmc-26 kmc)	12.0	≠5 db	-45 dbm
9. (26 kmc-40 kmc)	12.0	≠5 db	-45 dbm

In the proposed design the transistorized video preamplifiers will each have 3 transistors mounted on printed circuit boards. In the higher frequency bands the preamplifiers will plug into a compact assembly consisting of the preamplifier, the crystal detector and the horn antenna, figures that follow show typical circuits. Although the circuit shown in figures shown will not allow it, an attempt will be made to carry all current to the preamplifier on the signal coax. In case electrical crystal shutters are provided additional wires will be necessary to interconnect the Antenna Unit and the Control Console.

2. Control Console:

(a) Alert Units:

The Alert Units notify the operator of any

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activity of signals falling in the 50 mcs - 40 kmc band. The operator can immediately start analyzing and recording the activity. It is highly desirable to keep the uncollected activity to a minimum.

The use of cathode ray tubes as alert indicators are attractive because the operator can get the angular bearing of the signal more accurately than on a quadrant basis. The signals from each of the antennas (4 per frequency band) is separately detected and amplified. Each signal is fed to the deflection plate of the c.r.t. which corresponds to the direction of each antenna. As the beamwidth of the antennas are 90° the signals will add up on the display to give a deflection trace, the angle of which is proportional to the bearing of the signal source. An audible signal or a flashing light could augment the alert function so the operator would not have to be constantly viewing the cathode ray tube displays.

In the proposed equipment cathode ray tubes will be used while auxiliary alert devices will be included if they do not complicate the design and if they can be worked into the development program.

Each Alert Unit will contain a 1" - 1DP1 cathode ray tube with 4 transistorized, pulse stretching deflection amplifiers. Each Control Console will contain 9 Alert Units, or one for each frequency band. The pulse stretching circuit will enable the viewing of pulses with a low duty cycle. The deflection amplifiers will have a peak detector circuit, a medium level power transistor driving the c.r.t. deflection plates through a step-up transformer. Each Alert Unit will be a separate unit so that the Control Console may be separated into multiple sub-units in future models for use with more than one operator.

The cathode ray tubes in the Alert Units will all be supplied by one high voltage power supply. The power supply will use two transistors in an oscillator circuit.

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(b) Monitor Circuits

The Monitor Circuits will amplify and modify the signals from the preamplifiers for viewing and recording. The output will feed a Type 513D Tecktronix Oscilloscope for pulse viewing and p.r.f. counting, a set of earphones for aural monitoring the p.r.f., and a Magnecord tape recorder to record a log of the activity. It is assumed that in the operation of the proposed equipment only one operator will be used. Therefore, a switch is provided which will enable him to switch his earphones and an oscilloscope to any one of the 9 frequency channels. Provision will also be made to plug an auxiliary set of earphones and oscilloscope into any channel. The outputs of the 9 channels will also be available for connection to up to 9 tape recorders to enable separate recording of the activity on each frequency band.

The inputs from the preamplifiers will each feed into a single transistor buffer stage. The outputs of the buffer stages for each frequency band will be combined in a circuit using a single transistor for driving the auxiliary pulse viewing oscilloscope and the earphones. A level control will be placed across the phone output to reduce the signal to a comfortable monitoring level.

The combining amplifier will feed a two stage log amplifier to drive the tape recorder. The log amplifier will compress the expected range of input signals (-50 dbm to +22 dbm) into 20 db in order to not overload the tape recorder. The log characteristic will be obtained by using a varistor as the collector load of the transistors. The wide video bandwidths will be maintained in those monitor amplifiers.

A switch will be provided to reduce the low frequency response from 50 cps. cut-off frequency to 20 kc cut-off frequency to control voice modulation.

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(c) Power Supply:

The power supply will consist of a cadmium nickle battery to supply the approximately 280 transistors contained in the 81 amplifiers and high voltage power supply. The filaments of the cathode ray tubes will also be supplied from this battery although they take two times the power that the transistors will draw (12.6 watts for the filaments v.s. 6 watts for the transistors). The filaments could also be supplied from a small power supply operating from the ship supply.

(d) Control Console Packaging:

Since the equipment will be used by a single operator, all of the Alert Units, the monitor circuits, and the battery power supply will be housed in a single unit. The amplifiers will consist of plug-in, printed circuit boards which will readily lend themselves to possible repackaging of the Control Console at some later date. The controls will be placed for maximum ease of operation.

The auxiliary units such as the oscilloscope and the tape recorders will be placed adjacent to the Control Console. It is felt that each of these units will require a vibration mount, However, it is believed that the most advantageous approach would be to have the manufacturer of those units design the mounting for their units. Since a type 513D Tecktronix oscilloscope is being provided with each of the three equipments being delivered a vibration mount will be supplied for it. In the case of the tape recorders, however, the mounts are not considered to be a portion of this proposal.

C. PERFORMANCE TESTS:

While this proposal covers the complete testing of the R.F. and video circuits it does not cover extensive antenna pattern and gain checks over the wide frequency band at the contractor's plant. Test equipment of sufficient power to properly perform the antenna tests at all frequency does not

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exist at this facility. Since it does not appear economically sound to construct or procure all of this test equipment for this one contract, it is proposed to conduct the antenna performance tests at NRL or at a facility designated by the procuring agency.

V. ITEMS TO BE DELIVERED:

ITEM	QUANTITY	DESCRIPTION
1	3	Engineering Models of a Passive Intercept Receiving System generally in accordance with the Department of Defense Exhibit, titled "ELINT Maritime Receiving System-Prototype Design" and in accordance with this technical proposal. Included will be one (1) model 513D Tecktronic Oscilloscope.
2	3 sets	Spare Parts for Item 1 above. Each set will contain 50% spares for such items as amplifiers, tubes, etc., and 25% spares for durable hardware items such as antenna horns, etc.
3	10 copies	Final Engineering Report for work under Item 1 above. This report shall provide a summary of all work performed under Item I and shall include all information pertinent to the equipment delivered under Item I except that contained in the instruction guide of Item 4 below.
4	10 copies	Instruction and Operation Guide for the equipment delivered under Item 1 above. This informal instruction guide shall contain information on the theory of operation, installation, adjustment, operation, and maintenance of the Passive Intercept Receiving System.

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VI. DELIVERY DATES:

The delivery dates for the respective items to be supplied, as listed in Section V above, shall be as follows:

ITEM	DELIVERY DATES
1	First equipment within six months after receipt of executed copy of the contract. Second equipment within 30 days after delivery of first equipment. Third equipment within 60 days after delivery of first equipment
2	Concurrently with the equipment under Item 1.
3	Ninety days after delivery of first equipment under Item I.
4	Thirty days after acceptance and delivery of first equipment under item I.

It must be emphasized that the six months delivery date quoted above for the first equipment is extremely tight. The procurement of antennas with the required characteristics to cover the specturm below 1000 mc is foreseen to be the most difficult problem in meeting this delivery schedule. It would appear in the limited time that has been available to talk to antenna manufacturers that the low frequency, broad-band antenna art is in a rather embryonic state and that off the shelf units are not available. Several antenna manufacturers have expressed the opinion that they think that their current designs can be adapted to cover the desired ranges however. [redacted] has not been able to obtain firm commitments from any of them. Therefore, it should be noted that the delivery dates quoted above are based on the availability of low frequency antennas without having to engage in an extensive antenna development program. 25X1

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VII. TECHNICAL PUBLICATIONS

A. Handbooks

The handbook will consist of an informal instruction and operation guide for the subject equipment prepared in accordance with standard [redacted] practice. This handbook will contain information on the theory of operation, installation, adjustment, operation, and maintenance. 25X1

B. Drawings

The contractor will deliver to the procuring agency one (1) set of the contractor's design drawings. These drawings will be in accordance with the procedures used by [redacted] Corporation, for [redacted] procurement purposes. These drawings will not only include procurement, detail, and assembly, drawings, but they will also include schematics, outline drawings, and interconnecting cabling diagrams. Full breakdown assemblies and pictorial wiring diagrams will not be included. 25X1 25X1

C. Final Engineering Report

The final engineering report will provide a summary of all work performed under the contract. It shall provide a summary of all conclusions and recommendations. It will also contain a compilation of all performance and type tests on the units to be delivered. MIL-R-978 (Ships) will be used as a guide in preparing this report.

VIII. ENVIRONMENTAL TESTS

Temperature, humidity and Salt Spray tests shall be conducted in accordance with specification MIL-E-16,400.

Radio interference tests shall be conducted in accordance with specification MIL-I-16,910.

Vibration tests shall be conducted in accordance with specification MIL-T-17113.

Shock tests shall be conducted using a sand drop type machine instead of the hammer type with tests as nearly equivalent to the hammer drop tests as possible. Tests

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shall be conducted in accordance with MIL-T-5422C.

Since the equipment is urgently needed for field evaluation, the first unit will not be held up for environmental tests. Environmental testing will be performed on the second equipment to be delivered under this proposal after it has been returned to the [redacted] Corporation. 25X1

IX. GOVERNMENT LOANED EQUIPMENT:

The following government loaned equipment shall be supplied to [redacted] 25X1

1 One set of high frequency antenna drawings.

1 Passive Intercept Receiver System to be held for approximately one month for the duration of the environmental tests.

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